

 GENx-2B SERVICE BULLETIN - 73-0089 R01Revised:
01/11/2021SB 73-0089 R01 ENGINE FUEL AND CONTROL - FUEL NOZZLE MANIFOLDS (73-11-40) -
TOP MAIN FUEL MANIFOLD AND LOWER FUEL MANIFOLD INSPECTION - POST-GENX-2B S/B
73-0038Issued:
05/08/2020

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TRANSMITTAL INFORMATIONREVISION 1 TO SERVICE BULLETIN 73-0089

Revision 1 is issued to update the attached FST Procedure 2237 and paragraphs 1., [PLANNING INFORMATION](#), 2., [MATERIAL INFORMATION](#), and 3., [ACCOMPLISHMENT INSTRUCTIONS](#). The original was issued May 08, 2020. Revision bars in the left margin identify changes.

1. PLANNING INFORMATIONA. Effectivity

* * * GENx-2B67, -2B67B, -2B67/P

The redesigned top main fuel manifold P/N 2623M71G01 and lower fuel manifold P/N 2619M58G01 introduced on GENx-2B engine, serial number 959-521 and up or installed by GENx-2B S/B 73-0038 or GENx-2B S/B 73-0079 are affected by this Service Bulletin.

B. Description

This Service Bulletin provides instructions to do an inspection of the affected top main fuel manifold and lower fuel manifold for cracking adjacent to the support block pads.

NOTE: For on-wing engines, a visual inspection and an ultrasonic inspection are necessary.

NOTE: For in-shop engines, a repetitive inspection is required at every shop visit to perform a visual inspection and fluorescent penetrant inspection (FPI).

C. Compliance

Category 2

GE recommends that you do this Service Bulletin as soon as possible without effect on revenue service for engines with redesigned top main fuel manifold and lower fuel manifold that have accumulated 1,700 cycles or more since the first individual installation of the manifold. The cycle counting is accumulated on the top main fuel manifold and the lower fuel manifold since first installation.

On-Wing Requirement

A one-time inspection on wing is necessary at all ten support block pad locations for the top main fuel manifold and lower fuel manifold, repetitive inspection for on-wing engines is not required.

For the top main fuel manifold and/or lower fuel manifold that have 1,700 part cycles since new (PCSN) or more at the issue date of the original of this Service Bulletin, GE recommends completing the accomplishment instructions within 500 cycles from the issue date of the original of this Service Bulletin. For the top main fuel manifold and/or lower fuel manifold that have less than 1,700 PCSN at the issue date of this Service Bulletin, they must be inspected before the top main fuel manifold and lower fuel manifold reach 2,200 cycles since first installation.

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NOTE: For on-wing engines, if the top main fuel manifold and lower fuel manifold have been previously inspected by ultrasonic inspection as instructed by this Service Bulletin, and the top main fuel manifold and lower fuel manifold were found within serviceable limits, the engine is in compliance with the on-wing requirement instructed by this Service Bulletin.

NOTE: For engines that have complied with the on-wing requirement by the original revision of this Service Bulletin, no additional on-wing inspection is required.

NOTE: If multiple removals are present in the top main fuel manifold and lower fuel manifold, no multiple inspections on wing are required.

In-Shop Requirement

Repetitive visual inspection and FPI in shop are necessary at all ten support block pad locations for the top main fuel manifold and/or lower fuel manifold. This repetitive inspection is necessary for top main fuel manifold and/or lower fuel manifold above 1,700 PCSN at each shop visit, regardless if previous on-wing or in-shop inspections have been performed by this Service Bulletin.

Impact B

This recommendation is to address a condition that may result in an Increased Rate of In-Flight Shutdowns (IFSD), Take-Off Aborts (TOA), Air Turn Backs (ATB) or Diversions (DIV).

NOTE: This Service Bulletin can be done on wing or in shop.

This Service Bulletin is offered to improve the reliability or performance of your GE product, or to help prevent the occurrence of the event or condition described in this Service Bulletin. If the operator elects not to participate in the bulletin, that decision will be taken into consideration by GE in evaluating future product performance issues that may arise in the operator's fleet.

D. Concurrent Requirements

None.

E. Reason

(1) Objective:

To improve reliability.

(2) Condition:

A crack in a lower fuel manifold segment was found in service. The crack was found in the secondary fuel circuit (Psec) tube, adjacent to the braze that attaches the Psec tube to the support block pad, and had propagated sufficient to induce a fuel leak.

(3) Cause:

The cause of this cracking has been identified as low cycle fatigue, due to the abrupt transition created by the brazed support block pad that is unable to slide as intended due to thermal loads, resulting in stresses that exceed the material fatigue capability of the top main fuel manifold and lower fuel manifold.

(4) Inspection:

This Service Bulletin defines visual inspection, ultrasonic inspection, and FPI techniques for the top main fuel manifold and lower fuel manifold to make sure that there are no cracks in the top main fuel manifold and lower fuel manifold.

(5) Substantiation:

Substantiation is by fleet experience.

F. Approval

The data contained in this Service Bulletin has been reviewed by the FAA or authorized entity representing the FAA and the repair(s) and modification(s) herein comply with the applicable Aviation Regulations and are APPROVED for installation in the model(s) listed in this Service Bulletin.

G. Manpower

After you get access to the engine, you will need approximately 16 man-hours for one engine per aircraft, with an additional of 4 man-hours for two engines per aircraft, and an additional of 2 man-hours for each additional engine per aircraft, to accomplish this Service Bulletin.

H. Weight and Balance

Weight and balance are not changed.

I. References (Use the latest version of these documents)

GENx-2B, Boeing 747-8 Aircraft Maintenance Manual (AMM)
 GEK 9250, Commercial Engine Standard Practices Manual (SPM)
 GEK 114119, GENx-2B Engine Manual (EM)
 GEK 114120, GENx-2B Cleaning, Inspection, and Repair Manual (CIR)
 GEK 114122, GENx-2B Engine Illustrated Parts Catalog (EIPC)
 GENx-2B S/B 72-0130, ENGINE - Heat Shields (72-00-02) - Introduction of New Stainless Steel Heat Shields
 GENx-2B S/B 73-0034, ENGINE FUEL AND CONTROL - Fuel Nozzle Manifolds (73-11-40) - Fuel Manifold Field Inspection
 GENx-2B S/B 73-0038, ENGINE FUEL AND CONTROL - Fuel Nozzle Manifolds (73-11-40) - Introduction of New Fuel Manifold System Hardware
 GENx-2B S/B 73-0079, ENGINE FUEL AND CONTROL - General (73-00-00) - Fuel Manifold Intermix on GENx-2B Engines
 Field Support Technology (FST) Procedure 2237, GENx-2B Fuel Manifold Tube Ultrasonic Inspection

NOTE: The reference documents listed below are for the engine manufacturer's internal use only:
 BPP/EPEX No.: 19-72-40-83909

J. Publications Affected

None.

K. Interchangeability

Not applicable.

L. Software Accomplishment Summary

Not applicable.

2. MATERIAL INFORMATION

A. Material - Price and Availability

(1) Parts necessary to do this Service Bulletin:

None.

(2) Other Spare Parts:

Part Number	Qty/ Eng	Part Name	Unit (\$)	Price	Pkg Qty	Lead Time Days
2619M58G01	(1)	Manifold, Lower Fuel	47,730.00		(1)	5
2623M71G01	(1)	Manifold, Top Main Fuel	47,730.00		(1)	5

NOTE: Prices are provided for planning purposes and are subject to change.

(3) Consumables:

Code Number	Description
C02-019	Oil, Engine Lubricating (engine oil)
C02-023	Oil, Engine Lubricating (engine oil)
C04-035	General Solvent (isopropyl alcohol)

B. Industry Support Information

GE Aviation will provide the following industry support:

(1) Labor compensation in the form of a back-end service credit will be provided as follows based on the labor man-hours customer actually incurred in performing the inspection and based on the number of installed engines inspected per each aircraft maintenance check:

- *One engine serial number: Up to 16 man-hours
- OR
- *Two engine serial numbers: Up to 20 man-hours
- OR
- *Three engine serial numbers: Up to 22 man-hours
- OR
- *Four engine serial numbers. Up to 24 man-hours

(2) Labor compensation in the form of a back-end service credit will be provided for up to 4 labor man-hours actually incurred by customer in performing the inspection for each uninstalled engine.

(3) All labor man-hours will be credited at the customer warranty labor rate specified per the active general terms agreement (GTA) between GE and customer.

(4) The back-end service credit is available for customers who complete the inspection no later than two years from the issue date of this GENx-2B S/B 73-0089. All claims must be submitted to GE within 12 months of completion of the inspection and no later than three

years from the issue date of this GENx-2B S/B 73-0089.

- (5) Service credits may be applied by customer to future invoices for services, parts, and materials provided by GE Engine Services, LLC or GE Engine Services Distribution LLC.

All claims submitted to GE must contain complete information including:

- *Engine serial number
- *Date of compliance
- *Engine cycles since new and cycles since shop visit (installation of post-GENx-2B S/B 73-0038 top main fuel manifold and lower fuel manifold) at compliance
- *Documentation showing the labor man-hours incurred in completing the inspection
- *Reference customer dispensation number D-1240-3GO
- *Reference to GENx-2B S/B 73-0089 with current revision number

All claims must be submitted electronically via the myGEAviation.com portal. The support offered in this Service Bulletin is contingent on the customer having an active GTA for the applicable GE engine model. This offer may not be assigned or otherwise transferred to any other party without the written consent of GE, which consent shall be in the sole and complete discretion of GE. The offer is extended to the customer based on unique facts and circumstances, which the customer hereby acknowledges to be a non-precedent setting between the customer and GE. The commitment is subject to the terms and conditions of the current GTA between the customer and GE for the applicable GE engine model. By accepting the support listed in this section as offered by GE, the customer agrees that this Service Bulletin offering satisfies customer's commercial needs. The terms and conditions of the customer's GTA are applicable and remain in effect.

Please contact your Customer Support Manager (CSM) if you have any question regarding this support.

C. Configuration Chart

None.

D. Parts Disposition

Contact your local Field Service Engineer (FSE) or GE Aviation representative to return unserviceable top main fuel manifold and lower fuel manifold.

E. Tooling - Price and Availability

Tool Number	Description
GE-FQAP-677	GENx-2B Fuel Manifold Tube Ultrasonic Inspection Kit

To obtain an ultrasonic kit, additional items, or replacement items, contact the GE Inspection Technologies Group via the following method:

GE Inspection Technologies
50 Industrial Park Road
Lewistown, PA 17044
Attn: NDE Kit Coordinator
Email: ndttooling@ge.com

3. ACCOMPLISHMENT INSTRUCTIONS

A. General

- (1) This Service Bulletin gives instructions to do an inspection of the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2) for cracks with an ultrasonic inspection technique. The inspection only involves the Psec fuel tube of the top main fuel manifold (1) and lower fuel manifold (2) at locations adjacent to the ten support block pads.

NOTE: The ultrasonic inspection procedure is the same as the one instructed in GENx-2B S/B 73-0034. Same technique and equipment.

B. On-Wing Instructions

- (1) To safely open the left and right thrust reversers on the applicable engine, do as follows:

- (a) Make sure that the ENGINE START switch and the FUEL CONTROL switch are not operated as follows:

- 1 On the pilot's overhead panel, P5, make sure that the applicable ENGINE START switch is in the NORM (pushed-in) position and do as follows:
 - a Put a DO-NOT-OPERATE tag on the applicable ENGINE START switch.
- 2 On the pilot's aisle control stand, P8, make sure that the applicable FUEL CONTROL switch is in the CUTOFF position and do as follows:
 - a Put a DO-NOT-OPERATE tag on the applicable FUEL CONTROL switch.

WARNING: THE THRUST REVERSER MUST BE SECURELY HELD OPEN WHILE PERFORMING MAINTENANCE. ALWAYS BE SURE THE THRUST REVERSER IS FULLY AND PROPERLY SUPPORTED TO PREVENT INJURY TO PERSONS.

- (b) Make sure to do the tasks in the sequence that follows to safely open the left and right thrust reversers on the applicable engine as follows:

- 1 Retract the leading edge flaps. Refer to the GENx-2B, Boeing 747-8 AMM, 27-81-00, MAINTENANCE PRACTICES, TASK 27-81-00-862-019.
- 2 Do the deactivation of the retracted leading edge flaps. Refer to the GENx-2B, Boeing 747-8 AMM, 27-81-00, MAINTENANCE PRACTICES, TASK 27-81-00-042-023.
- 3 Do the deactivation of the thrust reverser for ground maintenance. Refer to the GENx-2B, Boeing 747-8 AMM, 78-31-00, MAINTENANCE PRACTICES, TASK 78-31-00-910-807-G00.
- 4 For the left and right fan cowl panels, open the applicable fan cowl panels. Refer to the GENx-2B, Boeing 747-8 AMM, 71-11-04, MAINTENANCE PRACTICES, TASK 71-11-04-010-801-G00 and Table 1 below:

Table 1

<u>Number</u>	<u>Name/Location</u>
413AL	Left Fan Cowl
414AR	Right Fan Cowl
423AL	Left Fan Cowl
424AR	Right Fan Cowl
433AL	Left Fan Cowl
434AR	Right Fan Cowl
443AL	Left Fan Cowl
444AR	Right Fan Cowl

- 5 For the left and right thrust reversers, open the applicable thrust reversers. Refer to the GENx-2B, Boeing 747-8 AMM, 78-31-00, MAINTENANCE PRACTICES, TASK 78-31-00-000-801-G00 and Table 2 below:

Table 2

<u>Number</u>	<u>Name/Location</u>
415AL	Left Thrust Reverser
416AR	Right Thrust Reverser
425AL	Left Thrust Reverser
426AR	Right Thrust Reverser
435AL	Left Thrust Reverser
436AR	Right Thrust Reverser
445AL	Left Thrust Reverser
446AR	Right Thrust Reverser

- (2) Before you start the inspection of the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2), you can remove the aft skirt heat shields (1, 2, and 3, [Figure 2](#)) and aft skirt segment heat shield (4), if necessary, to get access to the lower fuel manifold (2, [Figure 1](#)) as follows:

WARNING: REFER TO THE PRODUCT LABEL AND THE MANUFACTURER'S (MATERIAL) SAFETY DATA SHEET (SDS) FOR INSTRUCTIONS ON THE HAZARDS, STORAGE, SAFE HANDLING AND PROPER USE OF THIS PRODUCT.

- (b) Apply C02-019 or C02-023 engine oil to the channel nuts on the aft skirt heat shields (1, 2, and 3, [Figure 2](#)) and aft skirt segment heat shield (4) before the removal of the machine bolts (13).
- (c) If it is necessary to get better access to the lower fuel manifold (2, [Figure 1](#)), remove the aft skirt heat shield (1, [Figure 2](#)) as follows:
 - 1 Remove the machine bolts (9) that attach the cushioned loop clamps (10) and lower fuel manifold (11) to the tube and hose support bracket (12).
 - 2 Remove the six machine bolts (13) that attach the aft skirt heat shield (1) to the aft skirt heat shield (2) and aft skirt segment heat shields (5 and 6).
 - 3 Remove the aft skirt heat shield (1).
- (d) If it is necessary to get better access to the lower fuel manifold (2, [Figure 1](#)), remove the aft skirt heat shield (2, [Figure 2](#)) as follows:
 - 1 Remove the nine machine bolts (13) that attach the aft skirt heat shield (2) to the aft skirt heat shield (3), aft skirt segment heat shields (6 and 7), panel (14) and seal (15).
 - 2 Remove the aft skirt heat shield (2).
- (e) If it is necessary to get better access to the lower fuel manifold (2, [Figure 1](#)), remove the aft skirt heat shield (3, [Figure 2](#)) as follows:
 - 1 If necessary, remove the machine bolt (16) that attaches the support bracket (17) to the aft skirt heat shield (3).

NOTE: The machine bolt (16) and support bracket (17) apply to pre-GENx-2B S/B 72-0130 engines only.

 - 2 Remove the four machine bolts (13) that attach the aft skirt heat shield (3) to the aft skirt segment heat shields (4 and 7).
 - 3 Remove the aft skirt heat shield (3).
- (f) If it is necessary to get better access to the lower fuel manifold (2, [Figure 1](#)),

remove the aft skirt segment heat shield (4, [Figure 2](#)) as follows:

- 1 Remove the eight machine bolts (13) that attach the aft skirt segment heat shield (4) to the aft skirt segment heat shield (7) and main body assembly heat shield (8).
- 2 Remove the aft skirt segment heat shield (4).
- (3) If necessary, you can remove the support brackets attached to the top main fuel manifold (1) and lower fuel manifold (2) pigtails. Refer to GENx-2B S/B 73-0054.
- (4) After you get access, do a visual inspection of the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2) tubing and braze joints. Use a flashlight and mirrors as necessary.

WARNING: REFER TO THE PRODUCT LABEL AND THE MANUFACTURER'S (MATERIAL) SAFETY DATA SHEET (SDS) FOR INSTRUCTIONS ON THE HAZARDS, STORAGE, SAFE HANDLING AND PROPER USE OF THIS PRODUCT.

- (5) Clean the inspection areas of the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2) with C04-035 isopropyl alcohol.

CAUTION: LET THE TEMPERATURE OF THE TOP MAIN FUEL MANIFOLD (1), LOWER FUEL MANIFOLD (2), AND ADJACENT HARDWARE DECREASE TO AMBIENT TEMPERATURE BEFORE YOU DO THE ULTRASONIC INSPECTION OF THE TOP MAIN FUEL MANIFOLD (1) AND LOWER FUEL MANIFOLD (2). OTHERWISE, DAMAGE TO THE PROBES CAN OCCUR IF THEY CONTACT HOT SURFACES.

- (6) Do an ultrasonic inspection of the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2) for cracks in the pilot secondary fuel tube of the manifold assembly adjacent to the ten support block pads. Refer to paragraph 4., [APPENDIX - A](#) and as follows:
 - (a) If the ultrasonic inspection cannot be done on one of the brazed support block pad locations due to engine variation and possible clearance issues, do a class A FPI on the concerned brazed block location. Refer to the SPM, 70-32-03, SPOT-FLUORESCENT-PENETRANT INSPECTION or GENx-2B, Boeing 747-8 AMM, 70-11-06, MAINTENANCE PRACTICES, TASK 70-11-06-200-801-G00.
 - *Indications of 0.03 inch (0.8 mm) or less are permitted.

NOTE: This procedure can be done only if the ultrasonic inspection cannot be performed.

- (7) If you find cracks or leakage in the top main fuel manifold (1, [Figure 1](#)) and/or lower fuel manifold (2), replace the affected top main fuel manifold (1) and/or lower fuel manifold (2) as follows:
 - (a) For on-wing replacement of the top main fuel manifold (1, [Figure 1](#)), refer to GENx-2B S/B 73-0079.
 - (b) For replacement of the lower fuel manifold (2, [Figure 1](#)), you must remove the engine. Refer to GENx-2B S/B 73-0038.

NOTE: The lower fuel manifold (2, [Figure 1](#)) cannot be replaced on wing.

- (c) If you do not find cracks, no further inspection is necessary and the inspection is complete.
- (8) If you removed the support brackets attached to the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2) pigtails, install the support brackets before you install the aft skirt heat shields (1, 2, and 3, [Figure 2](#)) and aft skirt segment heat shield (4). Refer to GENx-2B S/B 73-0054.
- (9) If removed, install the aft skirt heat shields (1, 2, and 3, [Figure 2](#)) and aft skirt segment heat shield (4) again as follows:
 - (a) Install the aft skirt segment heat shield (4) as follows:
 - 1 Put the aft skirt segment heat shield (4) in its position on the main body assembly heat shield (8) and aft skirt segment heat shield (7).
 - 2 Install the eight machine bolts (13) that attach the aft skirt segment heat shield (4) to the main body assembly heat shield (8) and aft skirt segment heat shield (7).
 - 3 Torque the machine bolts (13) to 51 to 59 lb in. (5.7 to 6.6 Nm).
 - (b) Install the aft skirt heat shield (3, [Figure 2](#)) as follows:
 - 1 Put the aft skirt heat shield (3) in its position on the aft skirt segment heat shields (4 and 7).
 - 2 Install the four machine bolts (13) that attach the aft skirt heat shield (3) to the aft skirt segment heat shields (4 and 7).
 - 3 Torque the machine bolts (13) to 51 to 59 lb in. (5.7 to 6.6 Nm).
 - 4 If necessary, install the support bracket (17) to the aft skirt heat shield (4) with the machine bolt (16) and do as follows:

NOTE: The machine bolt (16) and support bracket (17) apply to pre-GENx-2B S/B 72-0130 engines only.

- a Torque the machine bolt (16) to 51 to 59 lb in. (5.7 to 6.6 Nm).
 - (c) Install the aft skirt heat shield (2, [Figure 2](#)) as follows:
 - 1 Put the aft skirt heat shield (2) in its position on the aft skirt segment heat shields (6 and 7), panel (14), seal (15), and aft skirt heat shield (4).
 - 2 Install the nine machine bolts (13) that attach the aft skirt heat shield (2) to the aft skirt segment heat shields (6 and 7), panel (14), seal (15), and aft skirt heat shield (4).
 - 3 Torque the machine bolts (13) to 51 to 59 lb in. (5.7 to 6.6 Nm).
 - (d) Install the aft skirt heat shield (1, [Figure 2](#)) as follows:
 - 1 Put the aft skirt heat shield (1) in its position on the aft skirt heat shield (2)

- and aft skirt segment heat shields (5 and 6).
 - 2 Install the six machine bolts (13) that attach the aft skirt heat shield (1) to the aft skirt heat shield (2) and aft skirt segment heat shields (5 and 6) and do as follows:
 - a Torque the machine bolts (13) to 51 to 59 lb in. (5.7 to 6.6 Nm).
 - 3 Install the machine bolts (9) that attach the cushioned loop clamps (10) and the lower fuel manifold (11) to the tube and hose support bracket (12) and do as follows:
 - a Torque the machine bolts (9) to 32 to 38 lb in. (3.6 to 4.2 Nm).
- (10) Put the airplane back to its usual condition as follows:
- (a) Do the tasks in the sequence that follows to safely close the left and right thrust reversers on the applicable engine as follows:
 - 1 For the left and right thrust reversers, close the applicable thrust reversers. Refer to the GENx-2B, Boeing 747-8 AMM, 78-31-00, MAINTENANCE PRACTICES, TASK 78-31-00-400-801-G00 and Table 3 below:

Table 3

<u>Number</u>	<u>Name/Location</u>
415AL	Left Thrust Reverser
416AR	Right Thrust Reverser
425AL	Left Thrust Reverser
426AR	Right Thrust Reverser
435AL	Left Thrust Reverser
436AR	Right Thrust Reverser
445AL	Left Thrust Reverser
446AR	Right Thrust Reverser
2	For the left and right fan cowl panels, close the applicable fan cowl panels. Refer to the GENx-2B, Boeing 747-8 AMM, 71-11-04, MAINTENANCE PRACTICES, TASK 71-11-04-410-801-G00 and Table 4 below:

Table 4

<u>Number</u>	<u>Name/Location</u>
413AL	Left Fan Cowl
414AR	Right Fan Cowl
423AL	Left Fan Cowl
424AR	Right Fan Cowl
433AL	Left Fan Cowl
434AR	Right Fan Cowl
443AL	Left Fan Cowl
444AR	Right Fan Cowl
3	Do the activation of the retracted leading edge flaps. Refer to the GENx-2B, Boeing 747-8 AMM, 27-81-00, MAINTENANCE PRACTICES, TASK 27-81-00-442-027.
4	Do the activation of the thrust reverser after ground maintenance. Refer to the GENx-2B, Boeing 747-8 AMM, 78-31-00, MAINTENANCE PRACTICES, TASK 78-31-00-910-808-G00.
(b)	Do these steps to remove the DO-NOT-OPERATE tags from the applicable ENGINE START switch and FUEL CONTROL switch: <ol style="list-style-type: none"> 1 On the pilot's overhead panel, P5, remove the DO-NOT-OPERATE tag from the applicable ENGINE START switch and do as follows: <ol style="list-style-type: none"> a Put the applicable ENGINE START switch to the NORM (pushed-in) position. 2 On the pilot's aisle control stand, P8, remove the DO-NOT-OPERATE tag from the applicable FUEL CONTROL switch and do as follows: <ol style="list-style-type: none"> a Put the applicable FUEL CONTROL switch to the CUTOFF position.

C. In-Shop Instructions

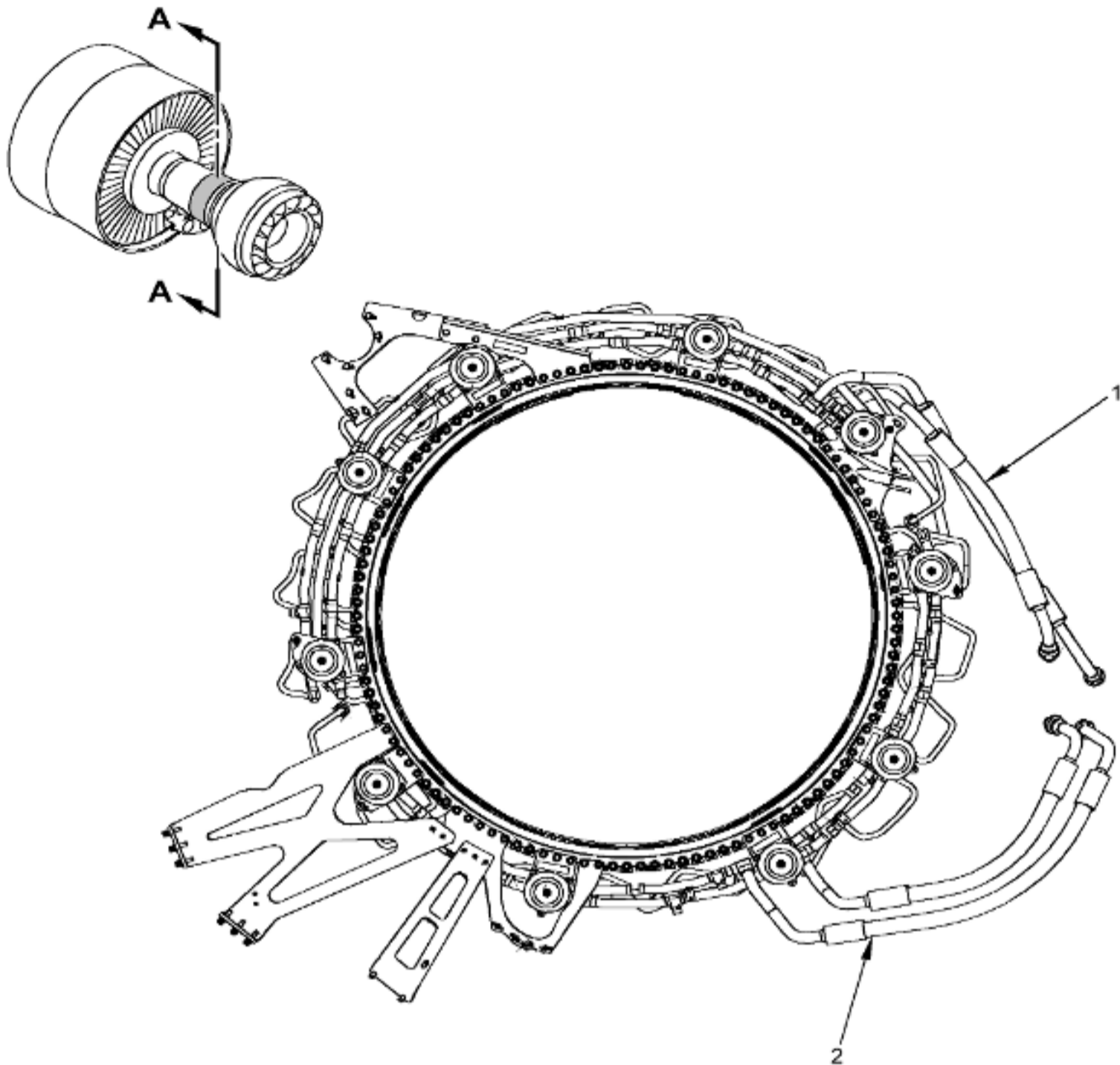
- (1) Remove the top main fuel manifold (1, [Figure 1](#)). Refer to the GENx-2B EM, 72-41-00, DISASSEMBLY 001, CONFIG 01, Subtask 72-41-00-040-024 or CONFIG 02, Subtask 72-41-00-040-032.
NOTE: GENx-2B S/B 73-0038 can be used as reference to help with the removal of the top main fuel manifold (1, [Figure 1](#)).
- (2) Remove the lower fuel manifold (2, [Figure 1](#)). Refer to the GENx-2B EM, 72-41-00, DISASSEMBLY 001, CONFIG 01, Subtask 72-41-00-040-024 or CONFIG 02, Subtask 72-41-00-040-032.
NOTE: GENx-2B S/B 73-0038 can be used as reference to help with the removal of the lower fuel manifold (2, [Figure 1](#)).
- (3) Do an inspection of the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2). Refer to the GENx-2B CIR, 72-41-80, INSPECTION 001.
NOTE: GENx-2B CIR, 72-41-80, INSPECTION 001 indicates that FPI of the brazed joints is not necessary. However, FPI of the brazed joints is necessary and must be accomplished as

specified in step 3.C.(4) of this Service Bulletin.

- (4) Do a Class A FPI of the ten brazed block joints on the top main fuel manifold (1, [Figure 1](#)) and lower fuel manifold (2). Refer to the SPM, 70-32-02, SPOT-FLUORESCENT-PENETRANT INSPECTION and do as follows:
 - (a) Indications of 0.03 inch (0.8 mm) or less are permitted.
- (5) Deleted.
- (6) If you find cracks or indications on the top main fuel manifold (1, [Figure 1](#)) or lower fuel manifold (2), replace the affected top main fuel manifold (1) and lower fuel manifold (2) and do as follows:
 - (a) Send the unserviceable top main fuel manifold (1) and/or lower fuel manifold (2) back to GE Aviation. Refer to paragraph 2.D., [Parts Disposition](#).
- (7) Install the top main fuel manifold (1, [Figure 1](#)). Refer to the GENx-2B EM, 72-40-00, ASSEMBLY 001, CONFIG 01, Subtask 72-40-00-440-023 or CONFIG 02, Subtask 72-40-00-440-052.

NOTE: GENx-2B S/B 73-0038 can be used as reference to help with the removal of the top main fuel manifold (1, [Figure 1](#)).
- (8) Install the lower fuel manifold (2, [Figure 1](#)). Refer to the GENx-2B EM, 72-40-00, ASSEMBLY 001, CONFIG 01, Subtask 72-40-00-440-023 or CONFIG 02, Subtask 72-40-00-440-052.

NOTE: GENx-2B S/B 73-0038 can be used as reference to help with the installation of the lower fuel manifold (2, [Figure 1](#)).
- (9) Do an engine test in a test cell as follows:
 - (a) Do a dry motoring check, an idle leak check, and a high power leak check. Refer to the GENx-2B EM, 72-00-00, TESTING 001 and TESTING 002.



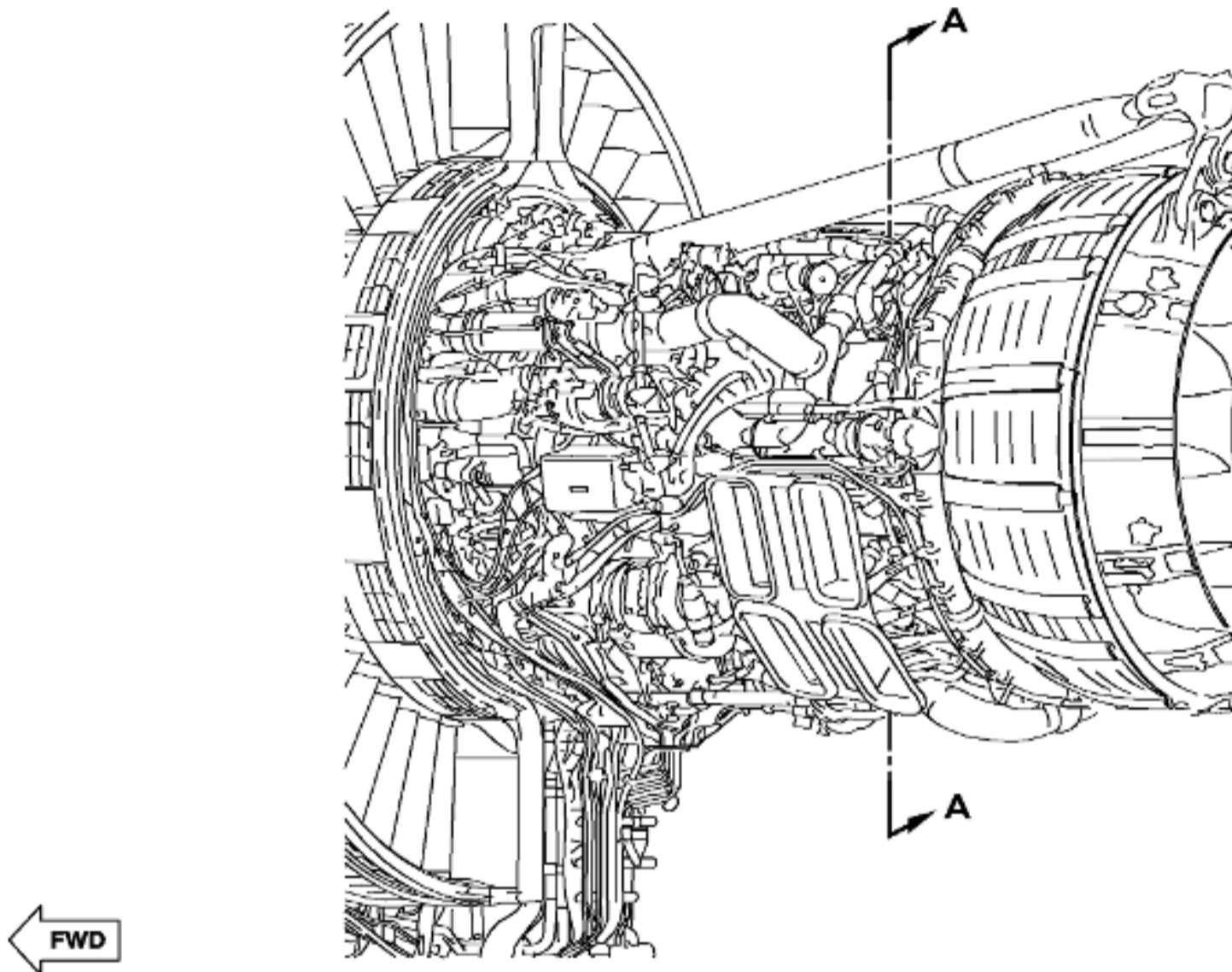
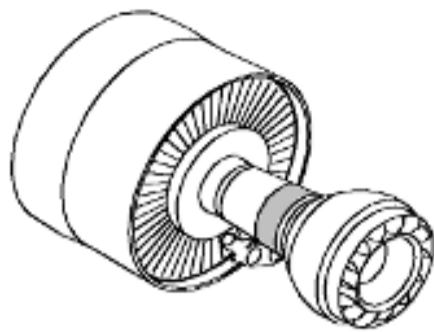
LEGEND:

- 1. TOP MAIN FUEL MANIFOLD
- 2. LOWER FUEL MANIFOLD

A-A
AFT LOOKING FORWARD

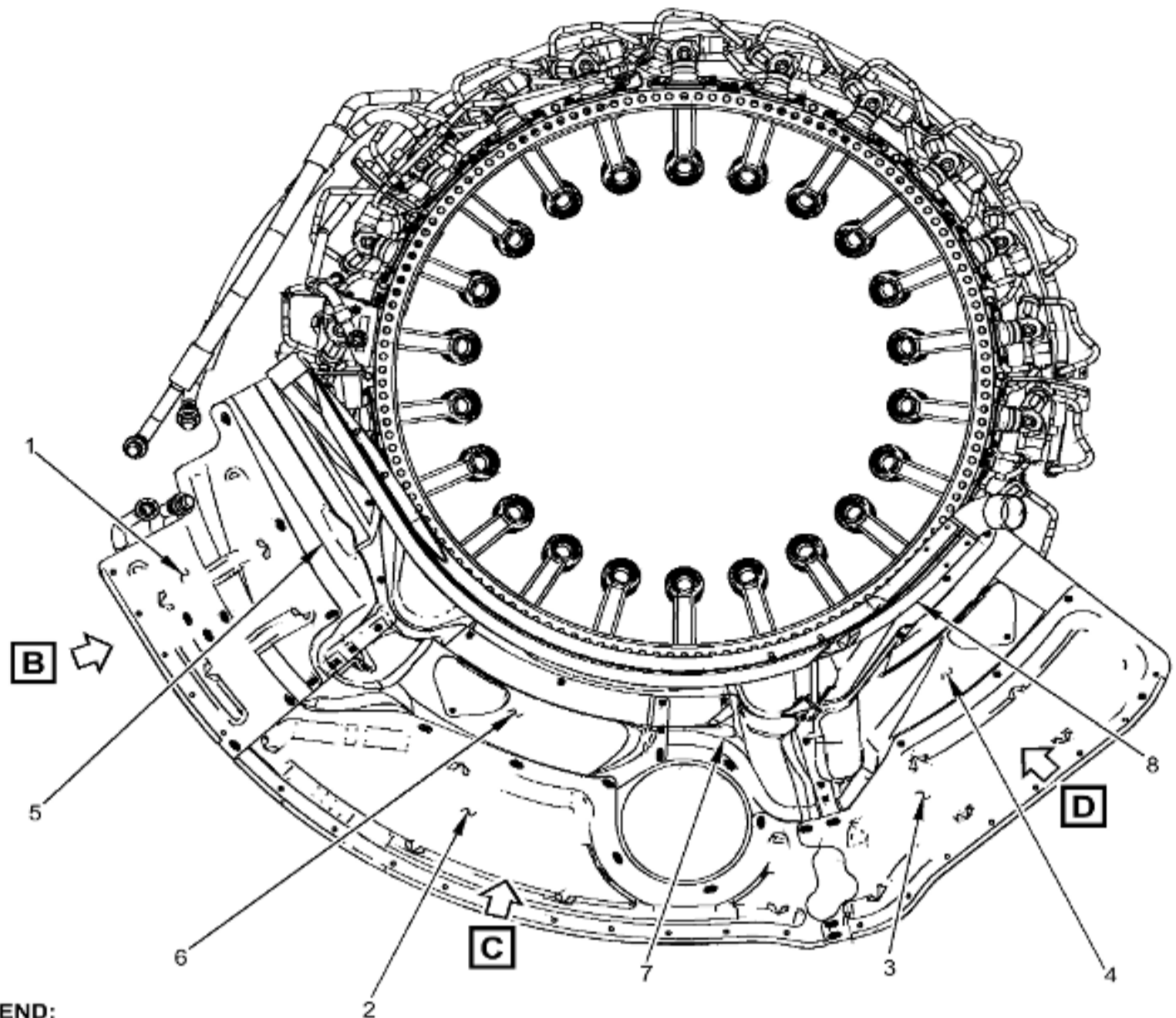
6016747-00

Top Main Fuel Manifold and Lower Fuel Manifold Location
Figure 1



6016729-00

Aft Skirt Heat Shield and Aft Skirt Segment Heat Shield Location
Figure 2 (Sheet 1)



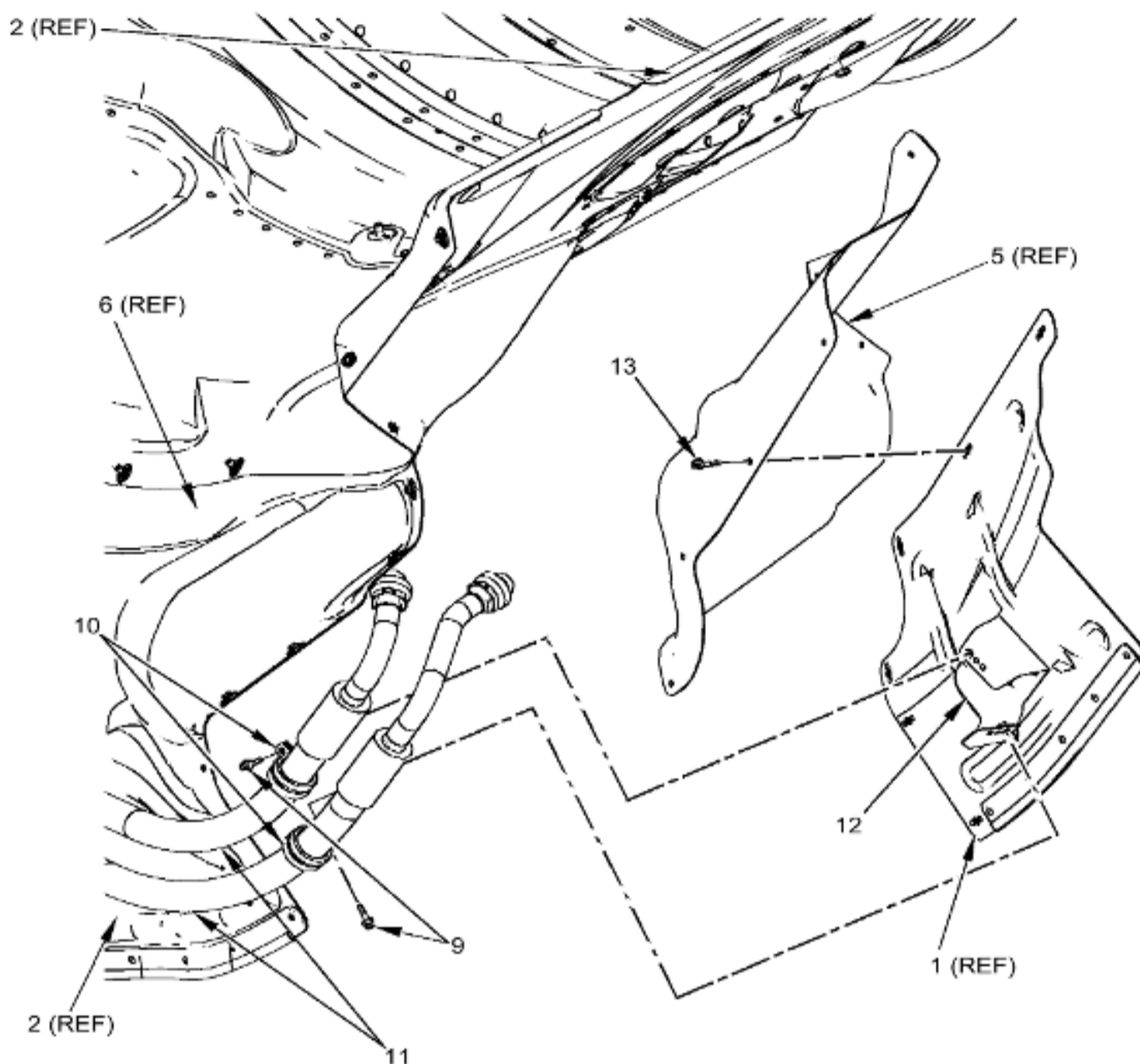
LEGEND:

1. AFT SKIRT HEAT SHIELD
2. AFT SKIRT HEAT SHIELD
3. AFT SKIRT HEAT SHIELD
4. AFT SKIRT SEGMENT HEAT SHIELD
5. AFT SKIRT SEGMENT HEAT SHIELD
6. AFT SKIRT SEGMENT HEAT SHIELD
7. AFT SKIRT SEGMENT HEAT SHIELD
8. MAIN BODY ASSEMBLY HEAT SHIELD

A-A
FORWARD LOOKING AFT

6016730-00

Aft Skirt Heat Shield and Aft Skirt Segment Heat Shield Location
Figure 2 (Sheet 2)



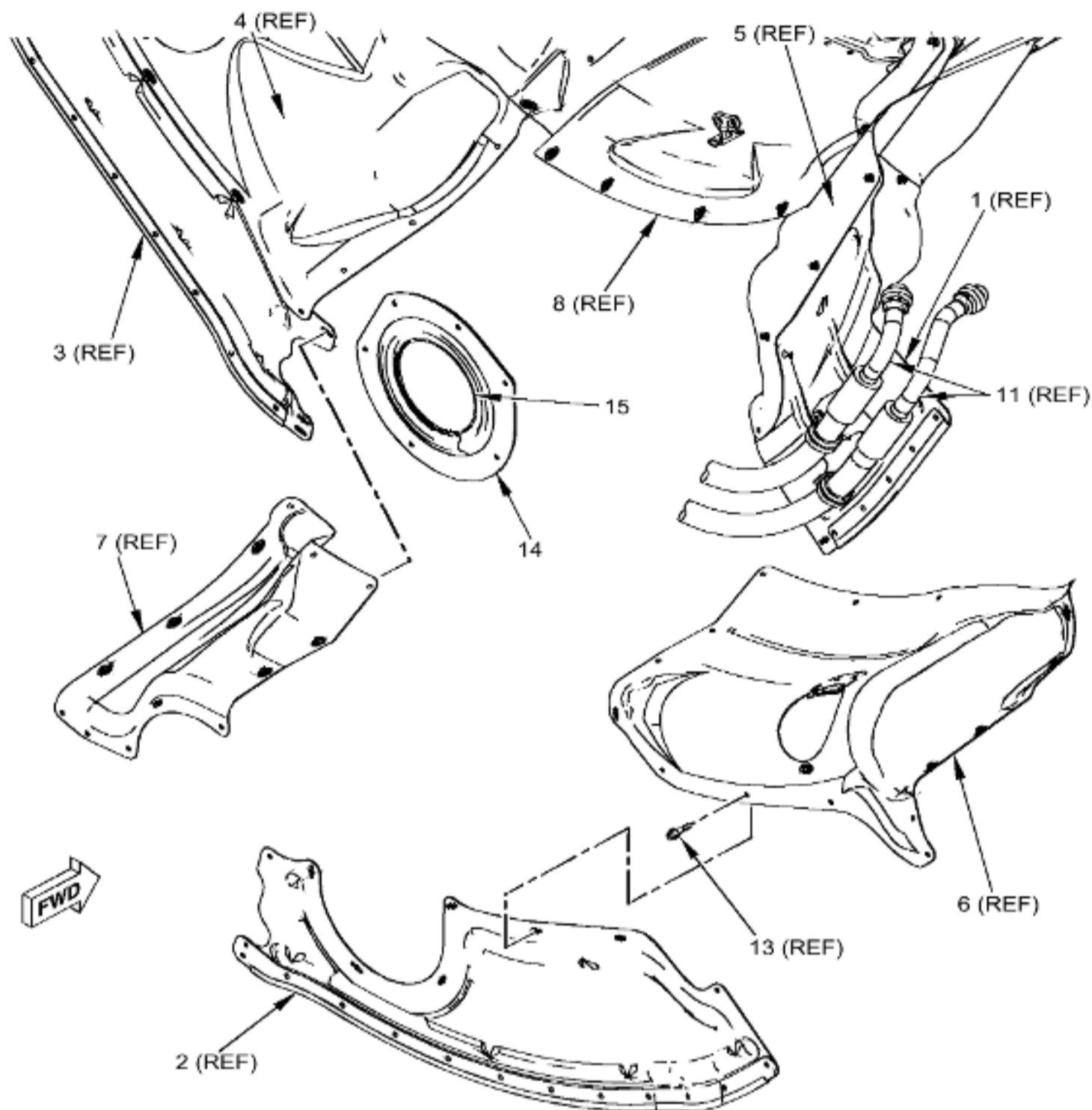
LEGEND:

- 9. MACHINE BOLT (QTY-2)
- 10. CUSHIONED LOOP CLAMP (QTY-2)
- 11. LOWER FUEL MANIFOLD
- 12. TUBE AND HOSE SUPPORT BRACKET
- 13. MACHINE BOLT (QTY-27)

B

6016731-00

Aft Skirt Heat Shield and Aft Skirt Segment Heat Shield Location
Figure 2 (Sheet 3)

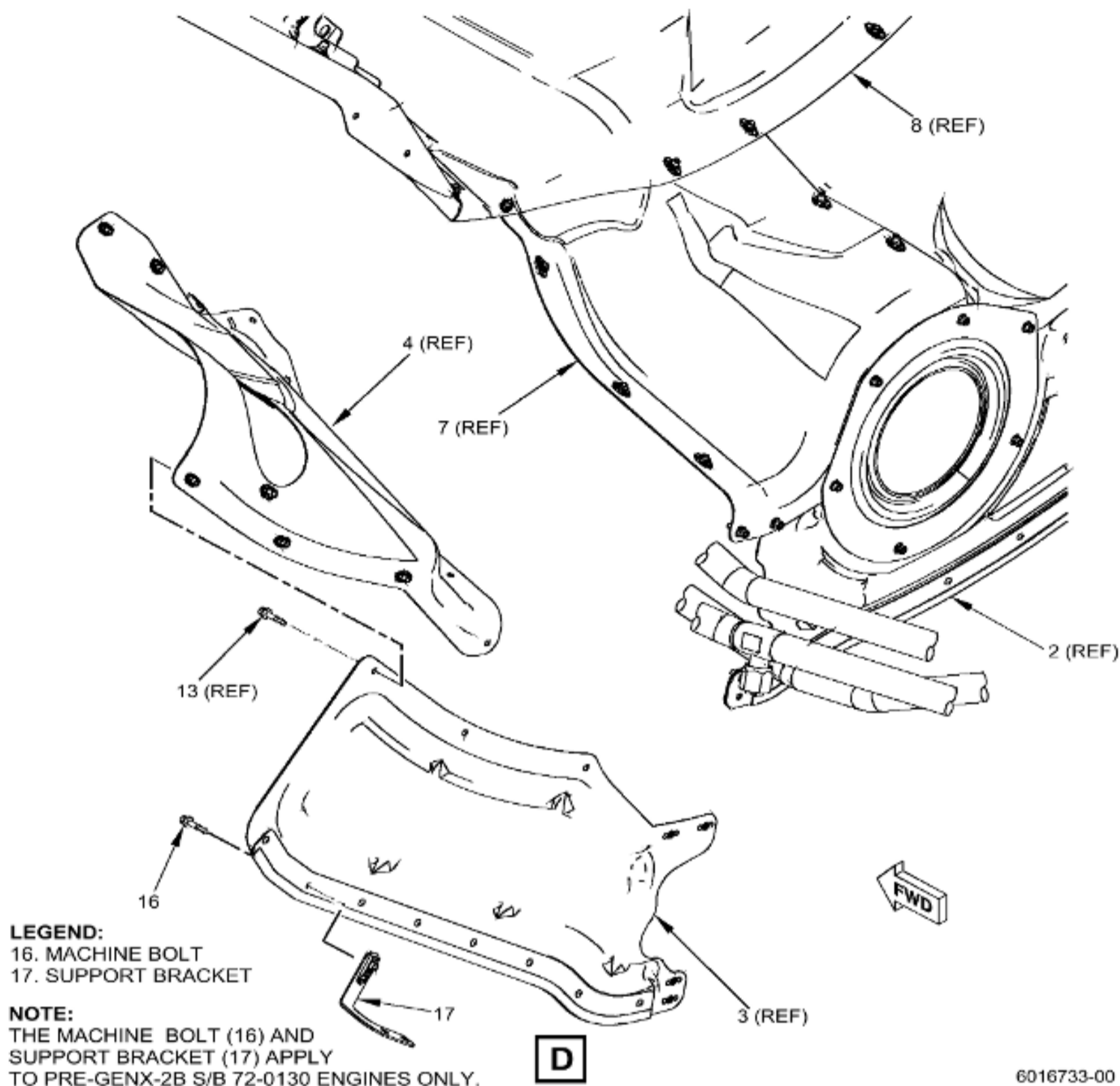


LEGEND:
14. PANEL
15. SEAL

C

6016732-00

Aft Skirt Heat Shield and Aft Skirt Segment Heat Shield Location
Figure 2 (Sheet 4)



Aft Skirt Heat Shield and Aft Skirt Segment Heat Shield Location
 Figure 2 (Sheet 5)

4. APPENDIX - A

A. Refer to the attached inspection procedure.

INSPECTION PROCEDURE

NUMBER: FST Procedure 2237
 ISSUE DATE: May 1, 2014
 APPLICABILITY: FST
 Inspection Sites

SUBJECT: GENx-2B Fuel Manifold Tube Ultrasonic Inspection		
Prepared by:	Certified Technical Approval:	Certifying Agent Approval / Issue
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@ 7	Michael Fields Senior Technologist Field Support Technology	Karen Morgan NDE Specialist Field Support Technology	Michael Fields Senior Technologist Field Support Technology

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1. SCOPE

- 1.1. This document describes the technique, equipment and procedure required for conducting an on-engine ultrasonic inspection of the GENx-2B fuel manifold for the detection of localized circumferential cracking adjacent to the support blocks. (Figures 1, 2, 3 and 4).
- 1.2. This inspection is performed using 2 dedicated ultrasonic probes each containing 4 elements. Two probes are required for the clockwise and counterclockwise directions around the manifolds. The probe wraps around the fuel lines and directs 70° shear waves toward the areas to be inspected. (Figure 2).
- 1.3. For specific cases where the procedures or equipment described herein cannot be applied in total, specific exceptions shall be obtained in writing from the appropriate technical function prior to any inspection of hardware.

2. APPLICABLE DOCUMENTS

- 2.1. NAS -410 (latest revision)
- 2.2. Applicable manufacturer's equipment user's manual
- 2.3. FST Procedure 2238 - Kit Preparation and Quality Assurance Plan

3. PERSONNEL REQUIREMENTS

- 3.1. Personnel performing this inspection must be certified in accordance with NAS-410, or American Society of Nondestructive Testing (ASNT-TC-1A) or local certification process.
- 3.2. It is strongly recommended that personnel performing this inspection receive practical training in the use of this procedure and must demonstrate proficiency in the calibration, inspection and evaluation routines before accept/reject authority is delegated.
- 3.3. Any training that may be provided regarding the performance of this inspection does not imply that the personnel who receive that training have met the requirements for inspector certification in accordance with the appropriate certification document.

4. EQUIPMENT REQUIREMENTS

- 4.1. The following is a listing of the equipment used for the inspection of the GENx-2B Fuel Manifold Tubes:

4.1.1. GE Aircraft Engines Inspection Kit GE-FQAP-677

Kit contents include:

Ultrasonic probe P/N 389-085-151	Qty 2
- Approved Alternate P/N 00-010012	
Ultrasonic probe P/N 389-085-161	Qty 2
- Approved Alternate P/N 00-010013	
Reference Standard P/N UT-2237	Qty 1
Standard Holder P/N SGP-155	Qty 1
Transducer Switch Box P/N 389-085-170	Qty 2
- Approved Alternate P/N 00-012260	
Syringe – Couplant Applicator	Qty 2
Probe application tool P/N SGP-156	Qty 2
Storage Case	Qty 1

4.1.2. Couplant – glycerin

4.1.3. Ultrasonic Instrument USM Go

4.1.4. Lemo to BNC Adaptor P/N 022-509-749

- 4.2. To obtain a kit, additional items, or replacement items, please submit a request to the following Email.

E:ndttooling@ge.com

5. INITIAL EQUIPMENT SETUP

NOTE: Refer to the manufacturer’s equipment manual for the ultrasonic instrument being utilized for this inspection if any questions arise about the instrument’s use.

- 5.1. Connect the ultrasonic instrument to the appropriate power source and switch the instrument power on. Allow the instrument to warm up for at least 10 minutes or the manufacturer’s recommended warm up time.
- @ 5.2. Connect the probe cable of the probe P/N 389-085-151 to be calibrated to the appropriate connector on the transducer switchbox.
- 5.3. Connect the transducer switch box to the instrument.
- 5.4. Fill the syringe with glycerin to be used for ultrasonic couplant.

- 5.5. Adjust the ultrasonic instrument to the basic settings in Table 1.

6. PRE-INSPECTION PREPARATION

- 6.1. Engines shall be prepared for inspection as follows (use appropriate technical data to accomplish):
- 6.1.1. Remove heat shield skirts numbers 1, 2 and 3.
- 6.2. The temperature of the fuel manifolds to be inspected shall be within a temperature range of 40°F to 100°F. Temperatures outside this range can adversely affect the inspection results, damage the transducer, or prevent proper coupling.

7. EQUIPMENT CALIBRATION

- 7.1. Each probe shall be calibrated separately; the method described below is the same for each probe. Refer to figures 5 and 6.
- 7.2. Prepare ultrasonic instrument and probe according to section 5.0 of this document.
- 7.3. Set the transducer switchbox to position number 1.
- 7.4. Open the spring-loaded halves of the probe and clamp the probe onto the calibration standard with the sound directed towards the probe stop (the spring tensioner will be pointed away from the probe stop) at a position approximately 0.5 inches away from the stop.
- 7.5. Apply couplant to the tube in front of the stop.
- 7.6. Move the probe forward until it is against the probe stop.
- 7.7. Rotate the probe slowly around the standard keeping the probe against the stop until the response from the EDM notch is detected.
- 7.8. Adjust the gain to set the response from the EDM notch to 80% of full screen height (FSH).
- 7.9. Adjust the instrument range so that the leading edge of the response from the EDM notch is at the fifth major division on the instrument baseline.
- 7.10. Note and record the instrument settings on Form 2237-1.
- 7.11. Adjust the transducer switchbox to position 2.

- 7.12. Rotate the probe slowly around the standard keeping the probe against the stop until the response from the EDM notch is detected.
- 7.13. Adjust the gain to set the response from the EDM notch to 80% of full screen height (FSH).
- 7.14. Note and record the instrument gain settings on Form 2237-1.
- 7.15. Repeat 7.11 through 7.14 for the remaining 2 switch positions.
- @ 7.16. The highest recorded gain will be used for inspection when using the probe P/N 389-085-151 for inspection.
- @ 7.17. Repeat 7.3 through 7.16 for probe P/N 389-085-161.

8. INSPECTION

CAUTION: Access to the areas of the fuel manifold to be inspected is difficult. Ensure that there are adequate platforms in place to so that each area can be reached easily and safely.

- 8.1. Assure that initial equipment set-up, pre-inspection preparation and system calibration are complete according to sections 5.0, 6.0, and 7.0 of this document.
- 8.2. Refer to Table 2 for the inspection areas and the probe to use.
 - 8.2.1. Inspect the upper block #2 and then the lower block #4. After inspection of these two locations, continue with the remaining block locations as instructed in Table 2.

NOTE: Per field experience, the upper block #2 and the lower block #4 have presented indications out of the permitted range criteria.

- 8.3. Select the probe to use for the area to be inspected.
- 8.4. Set the instrument gain for the probe to be used – refer to gains recorded per section 7.
- 8.5. Set a gate from 4.5 major divisions to the 7th major division on the instrument baseline at a level of 40% FSH. Refer to Figure 6.
- 8.6. Set the transducer switchbox to position number 1.

- 8.7. Open the spring-loaded halves of the probe and clamp the probe onto the tube (use the probe application tool as required, Figure 7). Ensure that the probe is oriented towards the fuel line support block and can be rotated around the tube while it is against the support block and pointed towards the braze area.
- 8.8. Pull the probe back slightly from the support block and apply couplant in front of the probe.
- 8.9. Move the probe against the support block and rotate the probe ensuring that the area of braze is covered as much as possible. Refer to Figure 4. Monitor the instrument for indications in the gate which equal or exceed 40% of FSH.

NOTE: Refer to Figure 6 to clearly understand the reject threshold of 40% and the inspection zone from 4.5 to 7.0 on the horizontal baseline.

CAUTION: Repeat inspections can deteriorate the inspection diligence causing incorrect inspection results. Consider break intervals to guarantee a proper inspection and prevent operator fatigue.

- 8.10. Repeat 8.9 for each switch position.
- 8.11. Upon completion of each inspection area, place a check mark in the appropriate box of the inspection log, Form 2237-1.
- 8.12. Evaluate repeatable indications which are equal to or exceed 40% FSH per section 10.0
- 8.13. Carefully remove the probe.
- 8.14. Repeat 8.2 through 8.12 for each area to be inspected.

9. CALIBRATION CHECK

- 9.1. A calibration check shall be performed after inspection. Also, check calibration whenever any system component or operator is changed, after any loss of power and at any time the operator suspects a change in the system.
- 9.2. If the amplitude of the response from the EDM notch for any of the transducers has increased by more than 20% FSH above the calibration amplitude, the system shall be recalibrated prior to the inspection of additional hardware. It will be necessary to re-inspect any rejected hardware examined since the last acceptable calibration once correct calibration has been achieved.

- 9.3. If the amplitude of the response from the EDM notch for any of the transducers has decreased by more than 10% FSH below the calibration amplitude, the system shall be recalibrated, and all hardware inspected since the last acceptable calibration or calibration check must be re-inspected.

10. INDICATION EVALUATION

- 10.1. Any indication(s) that equals or exceeds 40% FSH shall be evaluated as follows:

10.1.1. Verify that the calibration is acceptable per section 9.0.

10.1.2. Repeat the inspection using the correct gain for each transducer.

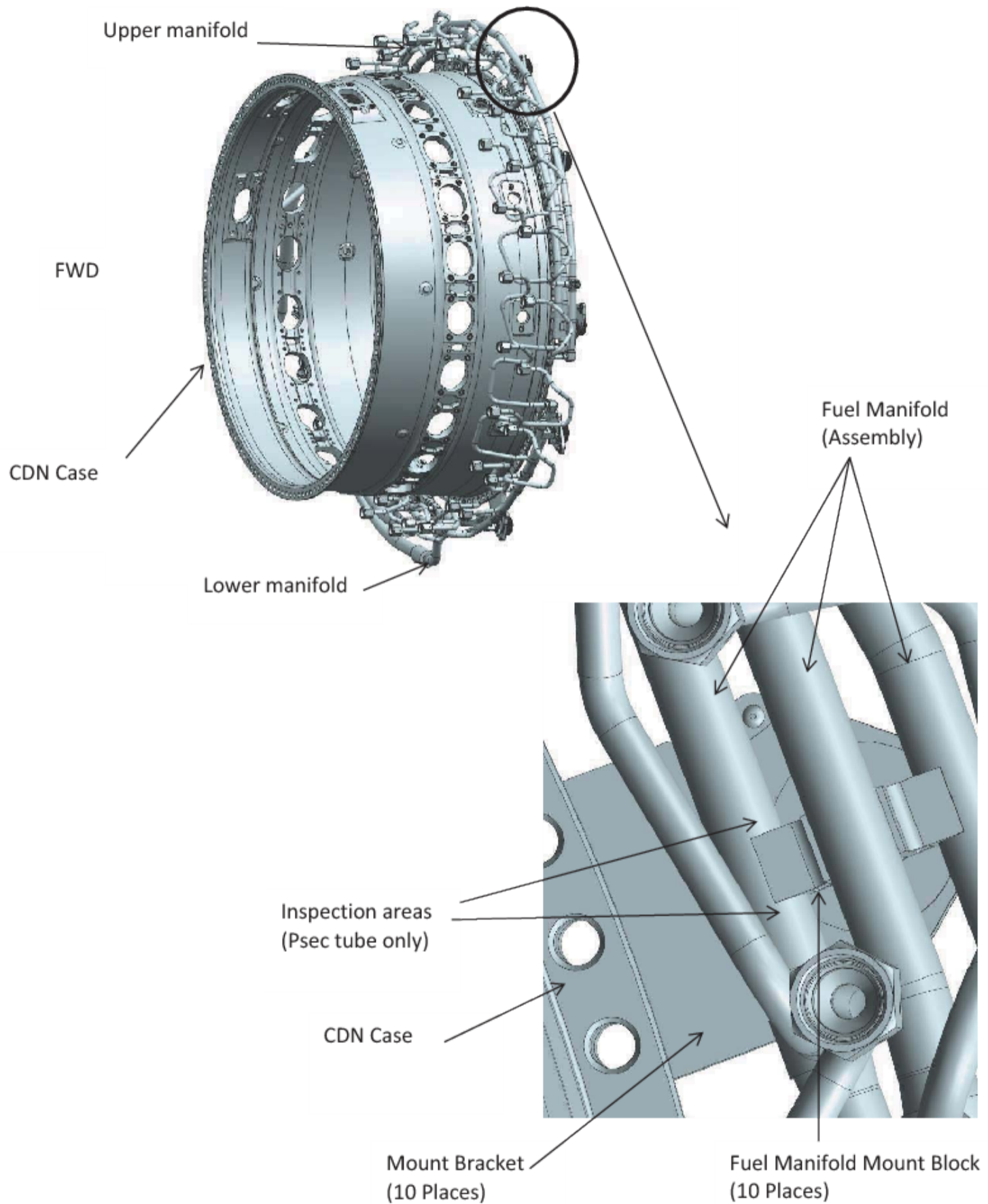
10.1.3. If the indication repeats and is equal to or exceeds 40% for any of the transducers (switch positions) the fuel manifold is rejectable.

10.1.4. Record the results on the data sheet Form 2237-1.

11. DOCUMENTATION

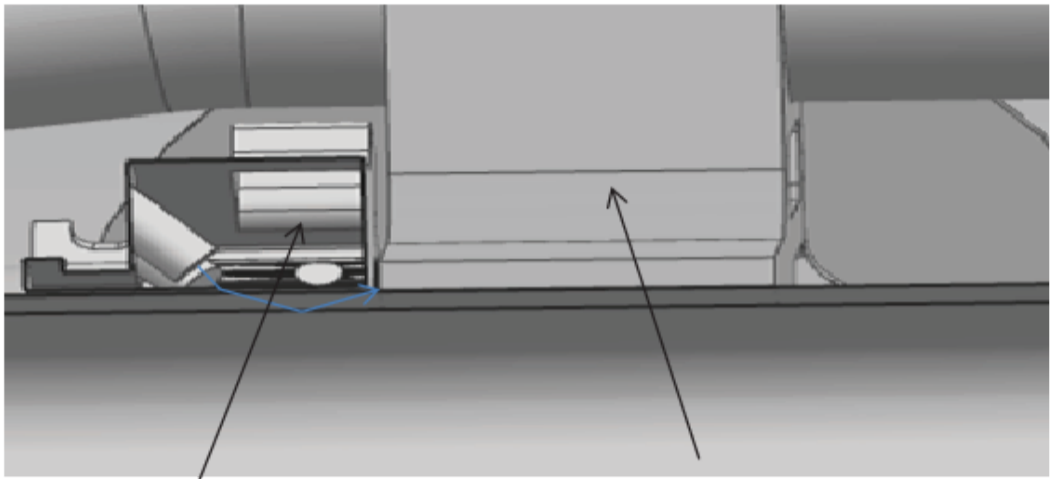
- 11.1. All calibration and inspection data shall be recorded on the appropriate log (Form 2237-1).
- 11.2. Forward Form 2237-1 along with any supporting electronic files to the appropriate GE Representative.

FIGURE 1 - FUEL MANIFOLD AND ASSEMBLY



FST Procedure 2237 GE Proprietary information - subject to restrictions on the cover page

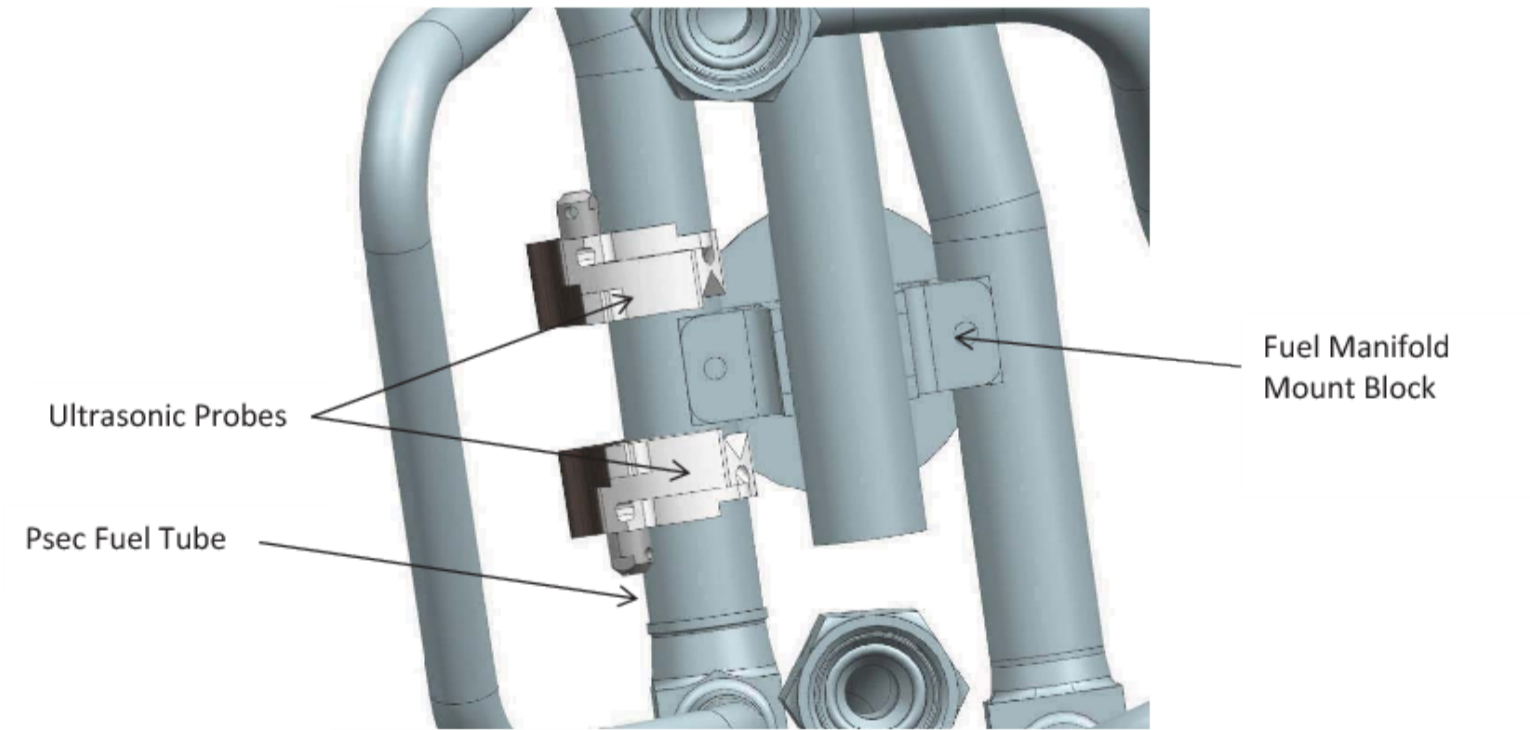
FIGURE 2 - INSPECTION METHOD



Ultrasonic Probe

Fuel Manifold Mount Block

Each element switched in turn, generates 70° shear wave in tube, and reflects off tube ID to target cracks originating from OD.



Probe P/N 389-085-151 positioned on Psec CW side and Probe P/N 389-085-161 positioned on the Psec CCW side.

FIGURE 3 - MANIFOLD MOUNT BLOCK LOCATIONS

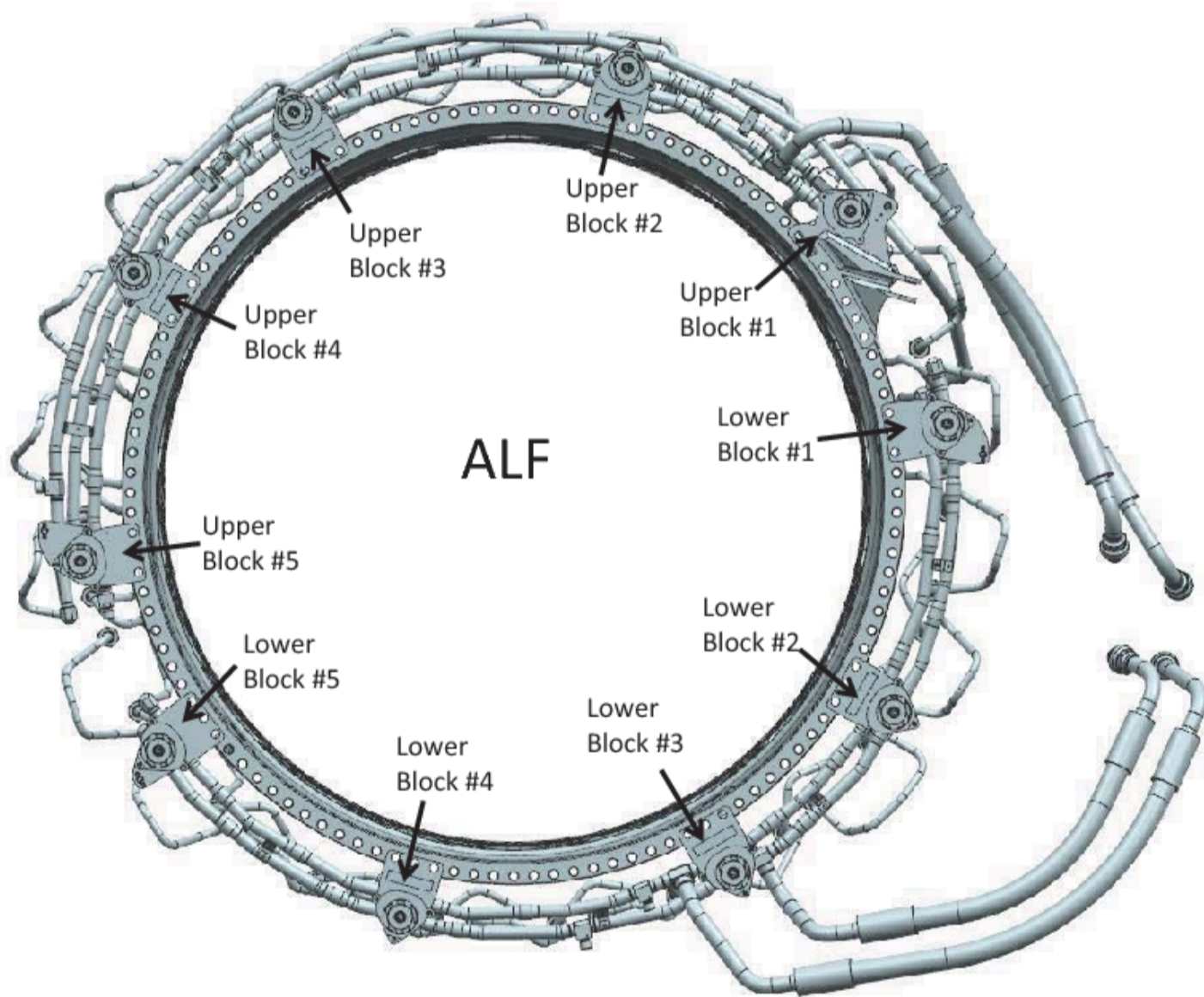
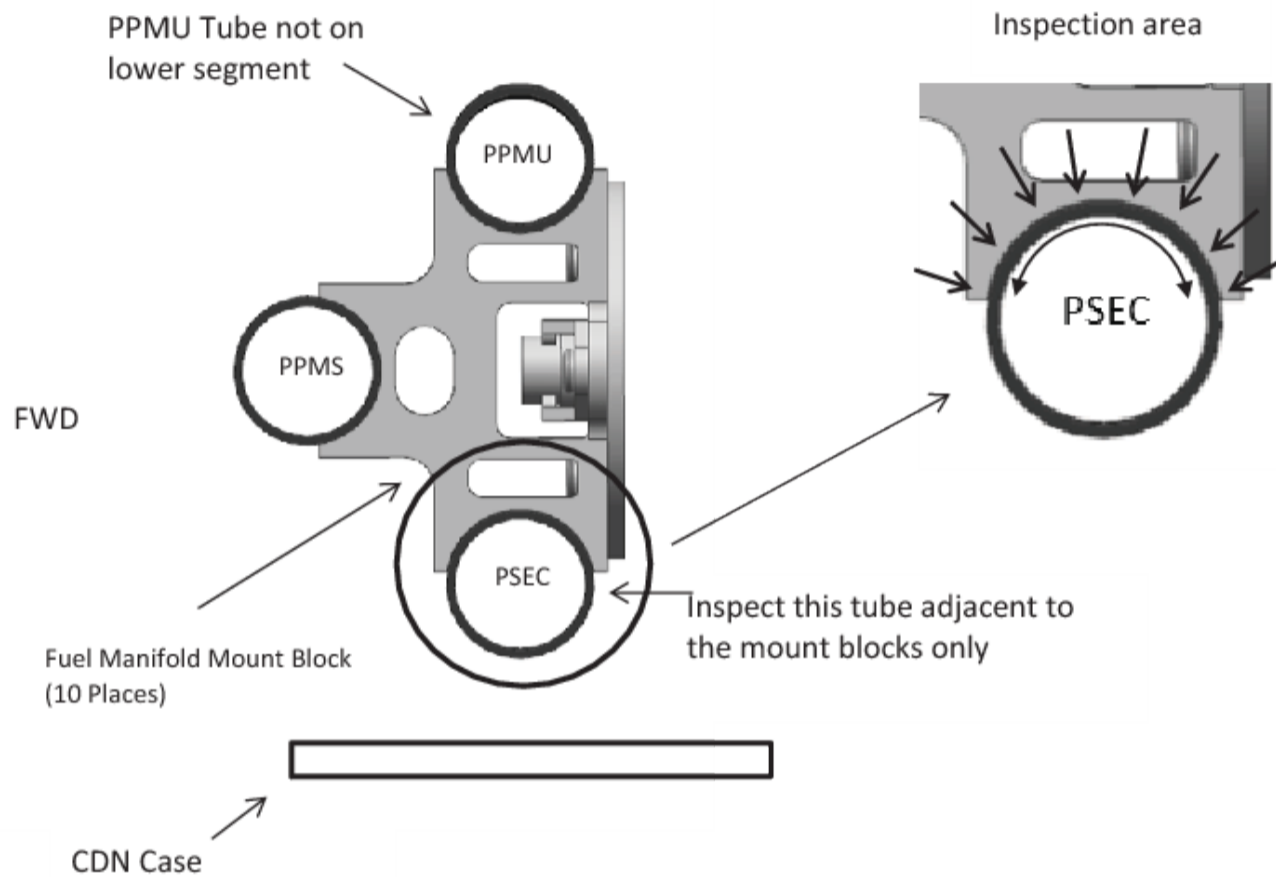


FIGURE 4 - FUEL MANIFOLD TUBE IDENTIFICATION AND INSPECTION AREA



Note: Only the Psec fuel tube inspection is required adjacent to the mount block locations.

FIGURE 5 - CALIBRATION STANDARD

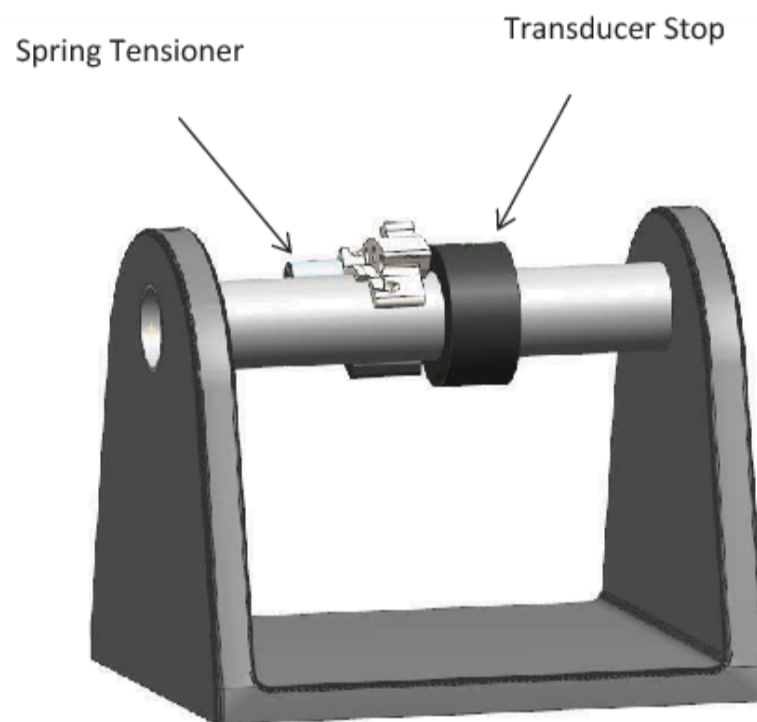


FIGURE 6 - SCREEN DISPLAY – CALIBRATION

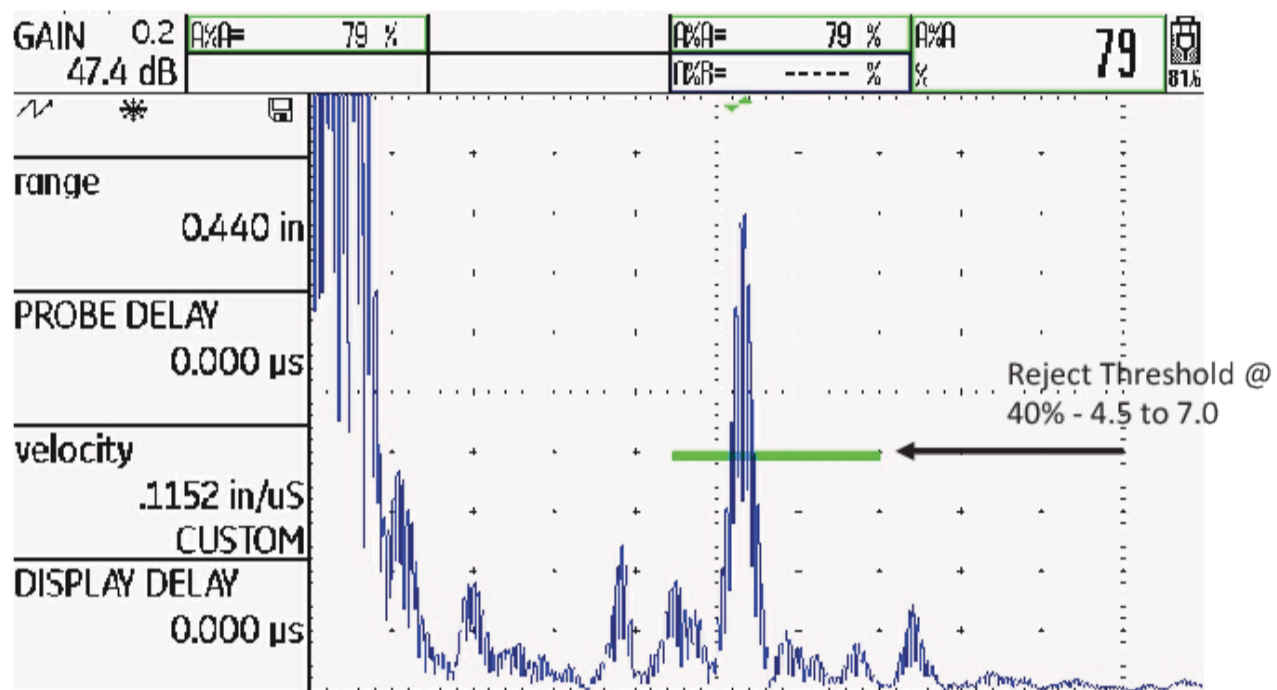


FIGURE 7 – PROBE APPLICATION TOOL



TABLE 1 - PRELIMINARY INSTRUMENT SETTINGS

@

USM GO/USM GO+

GAIN	50 dB
RANGE	0.500 in
VEL	0.1152 in/us
DISPLAY DELAY	0.00
PROBE DELAY	0.00
FREQUENCY	15 MHz
REJECT	0%
RECTIFICATION	FULLWAVE
DUAL	OFF
PULSER TYPE	SPIKE
PULSER ENERGY	LOW
DAMPING	50 OHM
VOLTAGE	LOW
PRF MODE	AUTO LOW 400 HZ
MAIN MENU	
FILE NAME	FUELMAN
ACTION	STORE REPORT
REPORT	
IMAGE IN REPORT	YES
PARAM IN REPORT	YES
VIDEO	
SOURCE/DEST	SD CARD
CONFIG2	
FUNCTION1	FREEZE/NONE
FUNCTION2	NONE/COPY

@

EPOCH XT

Control Description	Initial Setting	Control Description	Initial Setting
GAIN	50.0 dB	MODE	P/E
REJECT	0 %	FILTER	A 8.0 – 15.0
RANGE	.500 in	RECT	FULL
VEL	.1152 in/us		
ZERO	IP at 0.0		
M:PRF	400 Hz		
FREQ.	14.29 MHz		
ENERGY	125 V		
DAMP	50 ohms		

@

EPOCH – LTC

Control Description	Initial Setting	Control Description	Initial Setting
BASE		PULSER	
VEL	.1152	PRF	400 Hz
ZERO	IP at 0.0	DAMP	50 OHMS
ANGLE	NA	MODE	P/E
THICK	NA	ENERGY	100 V
RECEIVER		RANGE	
FILTER	HIGH PASS	RANGE	.500"
REJECT	0 %		
RECT	FULL	GAIN	55.0 dB

@

OLYMPUS Sonic 1000 Series

Control Description	Initial Setting	Control Description	Initial Setting
PULSER		RANGE	
PULSE	50ns	RANGE	0.424 in
DAMPING	50 ohms	DELAY	0.000
MODE	SINGLE	VELOCITY	0.115 in/us
VOLTAGE	150V	MAX REP	1200 Hz (HR series)
RCVR		GAIN	
DISPLAY	FULLWAVE	GAIN	50.0 dB
FREQ	WB		
REJECT	0 %		

@

EPOCH 600/650

Control Description	Initial Setting
GAIN	50.0 dB
BASIC	
Velocity	0.1152 in/μs
Zero	0.000 μs
Range	0.500
Delay	0.000
PULSER	
PRF Mode	Manual
PRF	400 Hz
Energy	200V
Damp	50 Ω
Mode	P/E
Pulser	Spike
RCVR	
Filter	5.0 – 15.0 MHz
Rect	Full

TABLE 2 - INSPECTION AREAS

	Psec Manifold	
	CCW	CW
Upper Block #1	161	151
Upper Block #2	161	151
Upper Block #3	161	151
Upper Block #4	161	151
Upper Block #5	161	151
Lower Block #1	161	151
Lower Block #2	161	151
Lower Block #3	161	151
Lower Block #4	161	151
Lower Block #5	161	151
151	Probe P/N - 389-085-151	
	Alt. P/N 00-010012	
161	Probe P/N - 389-085-161	
	Alt. P/N 00-010013	

FORM 2237-1 CALIBRATION AND INSPECTION LOG

DATE:		SITE:	
ENGINE SN:		INSPECTOR:	
INSTRUMENT S/N		STANDARD S/N:	

PROBE P/N 389-085-151 (P/N 00-010012)					PROBE P/N 389-085-161 (P/N 00-010013)				
S/N			RANGE		S/N			RANGE	
SWITCH	1	2	3	4	SWITCH	1	2	3	4
GAIN					GAIN				

	PSEC Manifold			
	CCW 161	CW 151		Comments
Upper Block #1				
Upper Block #2				
Upper Block #3				
Upper Block #4				
Upper Block #5				
Lower Block #1				
Lower Block #2				
Lower Block #3				
Lower Block #4				
Lower Block #5				
Post Calibration	Accept/Reject	Accept/Reject		

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